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APPLICATION FOR LETTERS PATENT

Logical Semantic Compression

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1 **TECHNICAL FIELD**

2 This invention relates to context-sensitive compression and, in particular, to
3 systems and methods to logically compress common semantic information
4 associated with data in a data set.

5

6 **BACKGROUND**

7 When a user of a client device, such as a personal computer, requests a data
8 search from a server device in a client-server computing architecture, the data
9 search can result in a large data set that is returned to the client. Typically, the
10 time that it takes to return a large data set to a client is delayed by a low bandwidth
11 connection at some point between the client device and the server device. This
12 delay can significantly increase the time between when the user requests the data
13 and when the data is displayed, or otherwise rendered, at the client device. In
14 many cases, the delay can be significant enough that a user will cancel the request
15 before the data is rendered for use. For an e-commerce site offering goods and/or
16 services on the Internet, for example, canceled requests for a list of products can
17 mean the difference between a successful or failed business venture.

18 The time that it takes to transmit data from one computing device to
19 another is a common problem with many network systems. Often a delay in data
20 transmission is likely to be caused by a low bandwidth connection associated with
21 the client device, such as a consumer in the e-commerce example. Although an
22 e-commerce site might be optimized to quickly serve a consumer request for data,
23 the consumer might be slow to receive the data due to a limitation of the
24 consumer's communication equipment, such as a common 56K modem.
25 Accordingly, there is a need to reduce the time that it takes to transmit data from

1 one device to another via a network system, while recognizing the limitations of
2 existing communication devices.

3 Server systems, such as Web sites for example, attempt to work around the
4 problem of a low bandwidth connection in relation to a large quantity of data to be
5 transmitted by simply limiting, or partitioning, the return data set. However,
6 partitioning or limiting a data set so that it can be returned in a reasonable amount
7 of time may not correspond to the expectations of a consumer, or user of a client
8 device, initiating the data request.

9 A consumer that initiates a request for all of the possible round-trip flight
10 combinations within a particular week, for example, does not want to receive only
11 ten choices when there are actually many more available to choose from.
12 Additionally, the provider of the information does not want the return data set
13 limited to only the ten choices because the consumer may choose to purchase the
14 flight tickets elsewhere, when in fact the flight combination that the consumer was
15 desiring was available, but not returned to the consumer as a possible choice.

16 This is a different type of data request from the typical search request where
17 a user of a client device initiates an Internet search for a particular product or
18 service and expects to receive the closest ten or so matches that correspond to the
19 search criteria. From the closest matching results, the user can then select a
20 particular provider of the product or service to make further inquiries.

21 For example, a consumer that desires to purchase a new portable computer
22 initiates a search for distributors of new computers. After receiving the top ten or
23 so matches that correspond to the request, the consumer can select a computer
24 distributor and further initiate a data request for all of the portable computers
25 available through the particular distributor. This data request is similar to the

1 consumer request for all of the possible round-trip flight combinations within a
2 particular week. The user does not want to receive only a few of the possible new
3 portable computer choices when the particular computer distributor actually has
4 many to choose from.

5 In addition to there being a need to reduce the time that it takes to transmit
6 data from one computing device to another via a network system, there is also a
7 need to be able to return a complete data set when requested, rather than only a
8 partial or incomplete list of the data.

9

10 **SUMMARY**

11 Individual records of a data set include data and semantic information to
12 describe the data. The records in the data set are encoded to generate an encoded
13 data set using a compression function. The compression function is determined, or
14 otherwise created, from semantic information that is common to multiple records
15 of the data set. The semantic information in a particular record is a combination of
16 the common data terms and/or data formatting information that is common to the
17 multiple records in the data set. Multiple records of the encoded data set include
18 the data without the common semantic information.

19 The encoded data set is transmitted, or otherwise communicated, to a
20 destination device along with an expansion function that includes the semantic
21 information that is common to the multiple records of the data set. The destination
22 device expands the encoded data set using the expansion function such that the
23 multiple records of the encoded data set are expanded to include the common
24 semantic information. The data in the multiple records of the encoded data set can

1 be rendered, or otherwise displayed, before or after the encoded data set is
2 expanded using the expansion function.

3 Additionally, a compression function can be determined, or otherwise
4 created, for a Web page structure that is common to multiple Web pages
5 associated with a Web site. An encoded Web page structure is generated by
6 removing the structure data that is common to the multiple Web pages.

7 The encoded Web page structure is transmitted, or otherwise
8 communicated, to a destination device along with an expansion function that
9 includes the common structure data. The destination device expands the encoded
10 Web page structure using the expansion function and the Web page is constructed
11 to display data received by the destination device.

12 BRIEF DESCRIPTION OF THE DRAWINGS

14 The same numbers are used throughout the drawings to reference like
15 features and components.

16 Fig. 1 is a block diagram that illustrates various components of a client-
17 server network architecture.

18 Fig. 2 illustrates a data set of records that include data and semantic
19 information in a data structure.

20 Fig. 3 is a block diagram that illustrates various components of a client-
21 server network architecture.

22 Fig. 4 is a block diagram that illustrates various components of a client-
23 server network architecture.

24 Fig. 5 is a flow diagram of a method for determining logical semantic
25 compression and expansion functions.

1 Fig. 6 is a flow diagram of a method for logical semantic compression and
2 expansion.

3 Fig. 7 is a flow diagram of a method for the logical semantic compression
4 and expansion of Web page structures.

5 Fig. 8 is a diagram of computing systems, devices, and components in an
6 environment that can be used to implement the invention described herein.

7

8 DETAILED DESCRIPTION

9 Introduction

10 The following describes systems and methods for logical semantic
11 compression which is context-sensitive compression, or data set encoding, of a
12 data set of records, where the records have both data and semantic information that
13 is common to multiple records in the data set. The semantic information in a
14 record is associated with the data in the record to describe, define, or otherwise
15 delineate the data. The semantic information in a particular record is a
16 combination of the common data terms and/or data formatting information that is
17 common to multiple records in the data set.

18 For a data set of records that have common semantic information, the
19 information can be compressed, or removed, from the records which will decrease
20 the time that it takes to transmit, or otherwise communicate, the data set from one
21 device to another via a network system. In addition, the common semantic
22 information can be transmitted from the one device to the other as an independent
23 function such that the records in the data set can be expanded to again include both
24 the data and the semantic information that describes the data.

Rather than transmitting each data set record from one device to another with both data and included semantic information, the actual size of the data set can be reduced by removing the common semantic information from the records and transmitting it only once. Reducing the size of the data set to be transmitted, or otherwise communicated, via a network system correlates to a decrease in the time that it takes to transmit the data set.

Exemplary System for Logical Semantic Compression

Fig. 1 illustrates a logical semantic compression system 100 having components that can be implemented within a computing network system having one or more devices. The logical semantic compression system 100 includes a server device 102, a client device 104, and a network system 106. See the description of “Exemplary Computing System and Environment” below for specific examples and implementations of network and computing systems, computing devices, and components that can be used to implement the invention described herein, including server device 102, client device 104, and network system 106.

Network system 106 can be any type of network, such as a local area network (LAN) or a wide area network (WAN), using any type of network topology and any network communication protocol. In this example, network system 106 includes a server-side modem 108, a client-side modem 110, and logical connections 112 to facilitate data communication between the various components.

Server device 102 has one or more processors 114 and a data storage component 116. Processor(s) 114 process various instructions to control the operation of server device 102. Data storage component 116 stores data 118, and

1 can be implemented as ROM (read only memory) and/or RAM (random access
2 memory), a disk drive, a floppy disk drive, a CD-ROM drive, or any other
3 component utilized for data storage. Similarly, client device 104 has one or more
4 processors 120 and a data storage component 122.

5 The logical semantic compression system 100 can be implemented as a
6 local area network computing system by a single entity that provides data from a
7 central location, such as from server device 102, to one or more kiosks, such as to
8 client device 104. Alternatively, the logical semantic compression system 100
9 can be implemented by two or more distinct entities that are connected via the
10 Internet, for example.

11 When client device 104 initiates a data search request, the request is
12 communicated to server device 102 via network system 106. A data search
13 request can be initiated by user interaction with client device 104, or the request
14 can be initiated automatically by an application executing on the client device
15 processor(s) 120.

16 When server device 102 receives a data search request, the server device
17 generates a data set from data 118 stored in the data storage component 116.
18 Those skilled in the art will recognize that server device 102 can be implemented
19 as multiple servers in a distributed computing environment, where each server can
20 have data storage components and searchable data to service a data search request.

21 Server device 102 has a compression function 124 that executes on
22 processor(s) 114 to reduce the size of a data set that is to be transmitted, or
23 otherwise communicated, to client device 104 via network system 106. From a
24 data set, server device 102 generates an encoded data set using the compression
25 function 124. Similarly, client device 104 has an expansion function 126 that

1 executes on processor(s) 120 to expand an encoded data set received from server
2 device 102. Expansion function 126 corresponds to compression function 124,
3 such that a data set encoded with the compression function can be expanded with
4 the expansion function. Server device 102 and client device 104 can include
5 multiple corresponding compression and expansion functions.

6 Client device 104 stores received data 128 in the data storage component
7 122. When client device 104 receives an encoded data set from server device 102,
8 the client device can expand the encoded data set with expansion function 126 and
9 store the data set as received data 128. Alternatively, client device 104 can store
10 the encoded data set as received data 128 without expanding the encoded data set.
11 An encoded data set will require less space to store in data storage component 122
12 than will the data set after being expanded using the expansion function 126. In
13 addition, client device 104 can route the data set to be printed or displayed, such as
14 on a display device.

15 Fig. 2 illustrates a data set 200 of multiple records 202 through 210 that can
16 be maintained in a data structure. The records 202 through 210 are an example of
17 a data set derived from data 118 maintained by server device 102 in the data
18 storage component 116 (Fig. 1). Individual records 202 through 210 in data set
19 200 include a time field 212, an airline field 214, a date field 216, a departing
20 airport field 218, a departing city field 220, an arrival airport field 222, and an
21 arrival city field 224.

22 Each of the record fields 212 through 224 can contain any numerical or
23 alphanumerical value that uniquely identifies the data in the fields. Additionally,
24 the combination of records and fields shown in data set 200 are merely an example
25 to illustrate logical semantic compression. Those skilled in the art will recognize

1 that any combination of records, fields, and data can be created and defined as a
2 data set in a data structure, such that the combination can be encoded with logical
3 semantic compression as described herein.

4 Individual records 202 through 210 include data about an airline flight, and
5 semantic information to describe the data. Semantic information in a record is
6 associated with the data in the record to describe, define, or otherwise delineate
7 the data. In this instance, the “data” is logically identified as the information in
8 time field 212 which indicates the departure and arrival time for a particular airline
9 flight. The departure and arrival times are identified as the “data” of the record
10 because the information in time field 212 varies with every record in data set 200.

11 The “semantic information” 226 is identified as data fields 214 through 224
12 which contain information that is common to the individual records 202 through
13 210 in data set 200. In this instance, the particular airline is commonly identified
14 as “Express” in airline field 214. Additionally, each Express airline flight departs
15 May 2nd (date 216) from the Seattle airport (SEA) (departing airport 218), which is
16 located in the city of Seattle (departing city 220), and arrives at the Los Angeles
17 International Airport (LAX) (arrival airport 222), which is located in the city of
18 Los Angeles (arrival city 224).

19 When client device 104 (Fig. 1), or a user at an airport kiosk for example,
20 initiates a data search request for all airline flights offered by Express airline on
21 May 2nd from Seattle to Los Angeles, the request is communicated to server device
22 102 via network system 106. When server device 102 receives the data search
23 request, the server device generates data set 200 (Fig. 2) from the data 118 stored
24 in the data storage component 116.

1 Server device 102 encodes data set 200 with compression function 124 by
2 removing the semantic information 226 that is common to the individual records
3 202 through 210 in data set 200. Compression function 124 is based on a context-
4 sensitive, or a logical, determination of which data in data set 200 is common to
5 multiple records in the data set (i.e., semantic information 226). The common data
6 in a particular record is grouped, or identified, as the semantic information for the
7 particular record.

8 Encoding data set 200 using compression function 124 reduces the size of
9 the data set before transmitting it to a destination device, such as client device 104.
10 In this instance, the encoded data set will include records 202 through 210 having
11 only the departure and arrival time information in time field 212. Reducing the
12 size of data set 200 before transmitting it to client device 104 via network system
13 106 directly translates to a decrease in the time that it takes to transmit the data set.

14 Expansion function 126 at client device 104 is also determined based on the
15 semantic information 226 that is common to the individual records 202 through
16 210 in data set 200. In this instance, expansion function 126 includes record fields
17 214 through 224. The expansion function is also transmitted to client device 104
18 via network system 106, such that when client device 104 receives the encoded
19 data set from server device 102, the encoded data set can be expanded using
20 expansion function 126. When records 202 through 210 are expanded with
21 expansion function 126 at client device 104, the client device will have a
22 completely restructured data set 200 that can be stored as received data 128.

23 The decrease in the time that it takes to transmit a requested data set to a
24 destination device is derived by removing semantic information that is common to
25 individual records in the data set, and transmitting the semantic information to the

1 destination device only once as part of an expansion function. In this instance,
2 semantic information 226 is transmitted from server device 102 to client device
3 104 only once as part of expansion function 126.

4 Logical semantic compression and expansion functions for a data set can be
5 determined and created prior to receiving any query or search request for data.
6 The developer of a database that data sets are generated from, having prior
7 knowledge of the records structure, can create or develop the compression and
8 expansion functions that will be applicable to multiple records in the server
9 database. Those skilled in the art will recognize that a server database can
10 maintain multiple records of varying structure, and that multiple compression and
11 expansion functions can be created prior to a data set request to accommodate
12 logical semantic compression of a particular data set with identified compression
13 and expansion functions.

14 **Exemplary System for Logical Semantic Compression**

15 Fig. 3 illustrates a logical semantic compression system 300 having
16 components that can be implemented within a computing network system having
17 one or more devices. The logical semantic compression system 300 includes a
18 server device 102, a client device 302, and a network system 304. See the
19 description of “Exemplary Computing System and Environment” below for
20 specific examples and implementations of network and computing systems,
21 computing devices, and components that can be used to implement the invention
22 described herein, including server device 102, client device 302, and network
23 system 304.

24 Network system 304 can be any type of network, such as a local area
25 network (LAN) or a wide area network (WAN), using any type of network

1 topology and any network communication protocol. In this example, network
2 system 304 communicates with client device 302 via a client-side modem 306, and
3 communicates with server device 102 via a server-side modem 308. Server device
4 102, and the various components of server device 102, are described above with
5 reference to Fig. 1.

6 Client device 302 has one or more processors 310 that process various
7 instructions to control the operation of client device 302. When client device 302
8 initiates a data search request, the request is communicated to server device 102
9 via network system 304 and modems 306 and 308. A data search request can be
10 initiated by user interaction with client device 302, or the request can be initiated
11 automatically by an application executing on the client device processor(s) 310. A
12 data search request can be in the form of a query for data in a server database, such
13 as the data storage component 116 in server device 102. When server device 102
14 receives a data search or query request, the server device executes the query
15 request and formulates a return data set from data 118 stored in the data storage
16 component 116.

17 Server device 102 has a compression function 124 that executes on
18 processor(s) 114 to reduce the size of a data set that is to be transmitted, or
19 otherwise communicated, to client device 302. Similarly, client device 302 has an
20 expansion function 312 that executes on processor(s) 310 to expand an encoded
21 data set received from server device 102.

22 Client device 302 has a Web browser application 314 that executes on
23 processor(s) 310 to facilitate requesting data from server device 102. Client
24 device 302 is connected with a display device 316 to display data received from
25 server device 102 via the Web browser application 314. When client device 302

1 receives an encoded data set from server device 102, the client device expands the
2 encoded data set using expansion function 312.

3 Fig. 3 illustrates an example of requesting a large data set from a Web site
4 (e.g., server device 102), and displaying the received data within a Web page 318
5 as individual data items 320 on the display device 316. Web page 318 illustrates
6 that client device 302 requested a data search of all music artists starting with the
7 letter “S” in the Rock category. Each music artists name 320 is a record hyperlink
8 having associated HTML (hypertext markup language) code that links to a
9 selected music artists’ home page where information about the artist can be found.

10 Multiple records in the music artist data set can be represented in the
11 following HTML format, where “Schtum” is the particular name of the music
12 artist associated with this record, and which corresponds to music artist 322 on
13 Web page 318:

```
14 <td>  
15 <a class=sublink  
16 href=http://www.website.com/MediaGuide/artistinfo/artistinfo.asp?  
17 p_id=P_2007>Schtum</a>  
18 </td>
```

19 Typically, all of the data in this record format is transmitted to the
20 destination device (e.g., client device 302) with every music artist record in the
21 data set to render the music artist record on Web page 318 and to provide the
22 functionality of a hyperlink for each particular record. Repeating the transmission
23 of all of the data in the record format for each music artist in the data set can
24 significantly increase the time that it takes to transmit the data set through a low
25 bandwidth connection, such as the client-side modem 306.

1 An expansion function for a music artist record in the data set can be
2 created by determining the semantic information that is common to the individual
3 records in the data set, and implementing a script function to remove the common
4 semantic information from the individual records.

5 The information that is common to the music artist records in this example
6 is “http://www.website.com/MediaGuide/artistinfo/artistinfo.asp?p_id=”. An
7 implementation of logical semantic compression results in the following
8 expansion function for the music artist records in the data set which includes the
9 information that is common to the music artist records:

```
10      function E(o)
11      {
12        url='http://www.website.com/MediaGuide/artistinfo/artistinfo.asp?p_id=' + o.p;
13        window.top.location = url;
14      }
```

15 This expansion function includes most of the common semantic
16 information from the music artist records in the data set. The compression
17 function encodes the individual records in the data set to generate an encoded data
18 set. The records in the encoded data set include the following data which is
19 transmitted to the destination device (e.g., client device 302) with every music
20 artist record in the data set:

```
21      <td>
22      <a class=sublink href=# p="P_2007" onclick="E(this);>Schtum</a>
23      </td>
```

24 This particular music artist record also corresponds to the artist data link
25 “Schtum” which is music artist 322 on Web page 318. In this example, each

1 record in the music artist data set is reduced in size from one-hundred and eleven
2 (111) characters to sixty-nine (69) characters which is approximately a 38%
3 overall reduction in the size of the data set that is transmitted to the destination
4 device. The reduction in size of the data set translates into a significant decrease
5 in the time that it takes to transmit, or otherwise communicate, the data set to
6 client device 302.

7 This example further illustrates the scalability of logical semantic
8 compression. The URL (uniform resource locator) in the expansion function,
9 which is common to multiple music artist records, can be increased to any number
10 of characters with no effect on the size of the encoded data set. This is because the
11 common semantic information included in the expansion function is transmitted to
12 the destination device only once.

13 Logical semantic compression can be applicable for any data set of videos,
14 songs, color palettes, wallpaper patterns, and the like, where the data itself is not
15 compressed, but the associated semantic information that describes the data in a
16 record is compressed. Generally, logical semantic compression can also be
17 applicable for any data set that has selectable data links, or HTML hyperlinks, and
18 common information associated with each data link. An example includes a Web
19 site that offers to create a list of items in a “shopping cart” for a consumer viewing
20 the Web site and selecting items to purchase. When the consumer selects an item,
21 common script code associated with a data link for each item adds the selected
22 item to the shopping cart list for the consumer. The common script code can be
23 compressed as semantic information before a data set of the items is transmitted to
24 the consumer’s computing device, and each item can be expanded to include the
25

1 common script code using an expansion function at the consumer's computing
2 device upon receiving the data set of selectable items.

3 **Exemplary Logical Semantic Compression for Page Structures**

4 Fig. 4 illustrates a logical semantic compression system 400 that can be
5 implemented to reduce the size of HTML code transmitted, or otherwise
6 communicated, from a Web page server 402 to a client device 302 via a network
7 system 304. Client device 302, network system 304, and the associated
8 components, are described above with reference to Fig. 3.

9 A Web site, such as an e-commerce business, that provides data when
10 requested can use common Web page structure data, including tables, text, and the
11 like, formatted for a uniform presentation across several pages of the Web site. A
12 Web site can implement Web server 402 that provides Web page structure 404 to
13 display requested data in a Web page. The Web page structure 404, which can be
14 HTML code, for example, includes a script function 406 that generates the Web
15 page structure when a Web page is requested by client device 302.

16 Typically, Web server 402 would provide Web page structure 404 and the
17 data to be displayed in the Web page with each Web page requested by client
18 device 302, which is then displayed as Web page 408 on display device 316. Web
19 page 408 has structure data 410 to identify the type of data that is to be filled in the
20 Web page 408.

21 Logical semantic compression can be utilized to reduce the size of a Web
22 page structure that will be transmitted to a destination device. Web server 402 has
23 one or more processors 412 that execute a compression function 414 to reduce the
24 size of Web page structure 404. When client device 302 requests a Web page,
25 Web server 402 can encode Web page structure 404 using compression function

1 414. Web page structure 404 can be encoded as a single character, such as an “@”
2 symbol for example. The single character is included in an expansion function
3 416 that is transmitted to client device 302.

4 Client device 302 executes expansion function 416 on processor(s) 310 and
5 can construct Web page 408 anytime that the client device requests data from Web
6 server 402 that will be displayed in Web page 408. In response to a request from
7 client device 302 for a Web page, Web server 402 can transmit the requested data
8 and the “@” symbol for the encoded Web page structure. Client device 302 can
9 build the Web page structure after expanding the “@” symbol using expansion
10 function 416, and render the data in the Web page 408 on display device 316.

11 **Methods for Logical Semantic Compression**

12 Fig. 5 illustrates a method for determining logical semantic compression
13 and expansion functions. The order in which the method is described is not
14 intended to be construed as a limitation. Furthermore, the method can be
15 implemented in any suitable hardware, software, firmware, or combination
16 thereof.

17 At block 500, a data set having multiple records is evaluated to determine
18 which of the records have data that is common to each of the records. The
19 multiple records include data that is common to each of the records, and data that
20 is not common to each of the records. At block 502, the data that is common to
21 the multiple records in the data set is identified as the semantic information. The
22 developer of a database that data sets are generated from, having prior knowledge
23 of the records structure, can evaluate the data to determine the common semantic
24 information. Additionally, an application program can evaluate a data set to
25 determine the common semantic information.

1 At block 504, a compression function for the data set is determined, or
2 otherwise created, from the semantic information that is common to the multiple
3 records in the data set. The compression function can be used to encode the data
4 set to reduce the size of the data set for storage, transmission, or similar purposes.
5 At block 506, an expansion function for the data set is determined, or otherwise
6 created, and includes the semantic information that is common to each of the
7 records in the data set. The expansion function can be used to expand the multiple
8 records in an encoded data set to include the common semantic information.

9 Fig. 6 illustrates a method for logical semantic compression and expansion.
10 The order in which the method is described is not intended to be construed as a
11 limitation. Furthermore, the method can be implemented in any suitable hardware,
12 software, firmware, or combination thereof.

13 At block 600, a request for a data set is received. At block 602, a
14 compression function for the data set is identified. The compression function can
15 be determined as described above with reference to Fig. 5. Additionally, the
16 compression function can be determined after receiving the request for the data
17 set, or before. Because context-sensitive compression is logically determined
18 based on the semantic information that is common to multiple records of a data
19 set, the compression function can be determined before the data set is requested.

20 At block 604, the data set is encoded using the identified compression
21 function to generate an encoded data set. The encoded data set is encoded by
22 removing the semantic information that is common to the individual records in the
23 data set. At block 606, an expansion function associated with the encoded data set
24 is identified. The expansion function can be determined as described above with
25

1 reference to Fig. 5. The expansion function includes the semantic information that
2 is common to multiple records in the data set.

3 At block 608, the expansion function is transmitted, or otherwise
4 communicated, to a destination device. At block 610, the encoded data set is also
5 transmitted, or otherwise communicated, to the destination device. At block 612,
6 the encoded data set is further compressed using a content compression algorithm
7 to generate a compressed encoded data set. A communication component such as
8 a modem, for example, can further compress the encoded data set when the
9 encoded data set is transmitted to the destination device.

10 At block 614, the compressed encoded data set is decompressed to
11 regenerate the encoded data set. A communication component associated with the
12 destination device, such as a destination device modem for example, can
13 decompress the compressed encoded data set when the destination device receives
14 the encoded data set. At block 616, the encoded data set is expanded using the
15 identified expansion function. The encoded data set is expanded such that
16 individual records in the encoded data set are expanded to include the common
17 semantic information. At block 618, the data from the expanded records in the
18 data set are displayed, or otherwise rendered.

19 As an alternative to the order in which blocks 616 and 618 are described,
20 the data from the individual records in the encoded data set can be displayed, or
21 otherwise rendered, at block 620. At block 622, the encoded data set is expanded
22 such that individual records in the encoded data set are expanded to include the
23 common semantic information. It is an implementation preference to display the
24 data first and then expand individual records of the encoded data set as needed, or
25 expand the encoded data set first and then display the data for each of the records.

1 Fig. 7 illustrates a method for determining logical semantic compression
2 and expansion functions for a Web page structure. The order in which the method
3 is described is not intended to be construed as a limitation. Furthermore, the
4 method can be implemented in any suitable hardware, software, firmware, or
5 combination thereof.

6 At block 700, a request for a Web page is received. At block 702, a
7 compression function for the Web page structure is determined. The compression
8 function can be determined by identifying the Web page structure data that is
9 common to multiple Web pages associated with a Web site.

10 At block 704, the Web page structure is encoded using the determined
11 compression function to generate an encoded Web page structure. For a Web site
12 that implements a common Web page structure for a uniform display of data
13 across several pages, the compression function can encode the Web page structure
14 as a single character, or similar identifier.

15 At block 706, an expansion function associated with the encoded Web page
16 structure is determined. At block 708, the expansion function is transmitted, or
17 otherwise communicated, to a destination device. At block 710, the encoded Web
18 page structure is also transmitted to the destination device. At block 712, the data
19 that will be displayed in the Web page is also transmitted to the destination device.

20 At block 714, the encoded Web page structure is expanded using the
21 determined expansion function. The encoded Web page structure is expanded
22 such that the Web page structure can be constructed for display. At block 716, the
23 Web page is displayed, such as on a display device connected to the destination
24 device, and at block 718, the data is displayed in the Web page.

1 **Exemplary Computing System and Environment**

2 Fig. 8 illustrates an example of a computing environment 800 within which
3 the computer, network, and system architectures described herein can be either
4 fully or partially implemented. Exemplary computing environment 800 is only
5 one example of a computing system and is not intended to suggest any limitation
6 as to the scope of use or functionality of the network architectures. Neither should
7 the computing environment 800 be interpreted as having any dependency or
8 requirement relating to any one or combination of components illustrated in the
9 exemplary computing environment 800.

10 The computer and network architectures can be implemented with
11 numerous other general purpose or special purpose computing system
12 environments or configurations. Examples of well known computing systems,
13 environments, and/or configurations that may be suitable for use include, but are
14 not limited to, personal computers, server computers, thin clients, thick clients,
15 hand-held or laptop devices, multiprocessor systems, microprocessor-based
16 systems, set top boxes, programmable consumer electronics, network PCs,
17 minicomputers, mainframe computers, gaming consoles, distributed computing
18 environments that include any of the above systems or devices, and the like.

19 Logical semantic compression may be described in the general context of
20 computer-executable instructions, such as program modules, being executed by a
21 computer. Generally, program modules include routines, programs, objects,
22 components, data structures, etc. that perform particular tasks or implement
23 particular abstract data types. Logical semantic compression may also be
24 practiced in distributed computing environments where tasks are performed by
25 remote processing devices that are linked through a communications network. In

1 a distributed computing environment, program modules may be located in both
2 local and remote computer storage media including memory storage devices.

3 The computing environment 800 includes a general-purpose computing
4 system in the form of a computer 802. The components of computer 802 can
5 include, by are not limited to, one or more processors or processing units 804, a
6 system memory 806, and a system bus 808 that couples various system
7 components including the processor 804 to the system memory 806.

8 The system bus 808 represents one or more of any of several types of bus
9 structures, including a memory bus or memory controller, a peripheral bus, an
10 accelerated graphics port, and a processor or local bus using any of a variety of
11 bus architectures. By way of example, such architectures can include an Industry
12 Standard Architecture (ISA) bus, a Micro Channel Architecture (MCA) bus, an
13 Enhanced ISA (EISA) bus, a Video Electronics Standards Association (VESA)
14 local bus, and a Peripheral Component Interconnects (PCI) bus also known as a
15 Mezzanine bus.

16 Computer system 802 typically includes a variety of computer readable
17 media. Such media can be any available media that is accessible by computer 802
18 and includes both volatile and non-volatile media, removable and non-removable
19 media. The system memory 806 includes computer readable media in the form of
20 volatile memory, such as random access memory (RAM) 810, and/or non-volatile
21 memory, such as read only memory (ROM) 812. A basic input/output system
22 (BIOS) 814, containing the basic routines that help to transfer information
23 between elements within computer 802, such as during start-up, is stored in ROM
24 812. RAM 810 typically contains data and/or program modules that are
25 immediately accessible to and/or presently operated on by the processing unit 804.

1 Computer 802 can also include other removable/non-removable,
2 volatile/non-volatile computer storage media. By way of example, Fig. 8
3 illustrates a hard disk drive 816 for reading from and writing to a non-removable,
4 non-volatile magnetic media (not shown), a magnetic disk drive 818 for reading
5 from and writing to a removable, non-volatile magnetic disk 820 (e.g., a “floppy
6 disk”), and an optical disk drive 822 for reading from and/or writing to a
7 removable, non-volatile optical disk 824 such as a CD-ROM, DVD-ROM, or other
8 optical media. The hard disk drive 816, magnetic disk drive 818, and optical disk
9 drive 822 are each connected to the system bus 808 by one or more data media
10 interfaces 826. Alternatively, the hard disk drive 816, magnetic disk drive 818,
11 and optical disk drive 822 can be connected to the system bus 808 by a SCSI
12 interface (not shown).

13 The disk drives and their associated computer-readable media provide non-
14 volatile storage of computer readable instructions, data structures, program
15 modules, and other data for computer 802. Although the example illustrates a
16 hard disk 816, a removable magnetic disk 820, and a removable optical disk 824,
17 it is to be appreciated that other types of computer readable media which can store
18 data that is accessible by a computer, such as magnetic cassettes or other magnetic
19 storage devices, flash memory cards, CD-ROM, digital versatile disks (DVD) or
20 other optical storage, random access memories (RAM), read only memories
21 (ROM), electrically erasable programmable read-only memory (EEPROM), and
22 the like, can also be utilized to implement the exemplary computing system and
23 environment.

24 Any number of program modules can be stored on the hard disk 816,
25 magnetic disk 820, optical disk 824, ROM 812, and/or RAM 810, including by

1 way of example, an operating system 826, one or more application programs 828,
2 other program modules 830, and program data 832. Each of such operating
3 system 826, one or more application programs 828, other program modules 830,
4 and program data 832 (or some combination thereof) may include an embodiment
5 of logical semantic compression.

6 Computer system 802 can include a variety of computer readable media
7 identified as communication media. Communication media typically embodies
8 computer readable instructions, data structures, program modules, or other data in
9 a modulated data signal such as a carrier wave or other transport mechanism and
10 includes any information delivery media. The term “modulated data signal”
11 means a signal that has one or more of its characteristics set or changed in such a
12 manner as to encode information in the signal. By way of example, and not
13 limitation, communication media includes wired media such as a wired network or
14 direct-wired connection, and wireless media such as acoustic, RF, infrared, and
15 other wireless media. Combinations of any of the above are also included within
16 the scope of computer readable media.

17 A user can enter commands and information into computer system 802 via
18 input devices such as a keyboard 834 and a pointing device 836 (e.g., a “mouse”).
19 Other input devices 838 (not shown specifically) may include a microphone,
20 joystick, game pad, satellite dish, serial port, scanner, and/or the like. These and
21 other input devices are connected to the processing unit 804 via input/output
22 interfaces 840 that are coupled to the system bus 808, but may be connected by
23 other interface and bus structures, such as a parallel port, game port, or a universal
24 serial bus (USB).

1 A monitor 842 or other type of display device can also be connected to the
2 system bus 808 via an interface, such as a video adapter 844. In addition to the
3 monitor 842, other output peripheral devices can include components such as
4 speakers (not shown) and a printer 846 which can be connected to computer 802
5 via the input/output interfaces 840.

6 Computer 802 can operate in a networked environment using logical
7 connections to one or more remote computers, such as a remote computing device
8 848. By way of example, the remote computing device 848 can be a personal
9 computer, portable computer, a server, a router, a network computer, a peer device
10 or other common network node, and the like. The remote computing device 848 is
11 illustrated as a portable computer that can include many or all of the elements and
12 features described herein relative to computer system 802.

13 Logical connections between computer 802 and the remote computer 848
14 are depicted as a local area network (LAN) 850 and a general wide area network
15 (WAN) 852. Such networking environments are commonplace in offices,
16 enterprise-wide computer networks, intranets, and the Internet. When
17 implemented in a LAN networking environment, the computer 802 is connected to
18 a local network 850 via a network interface or adapter 854. When implemented in
19 a WAN networking environment, the computer 802 typically includes a modem
20 856 or other means for establishing communications over the wide network 852.
21 The modem 856, which can be internal or external to computer 802, can be
22 connected to the system bus 808 via the input/output interfaces 840 or other
23 appropriate mechanisms. It is to be appreciated that the illustrated network
24 connections are exemplary and that other means of establishing communication
25 link(s) between the computers 802 and 848 can be employed.

1 In a networked environment, such as that illustrated with computing
2 environment 800, program modules depicted relative to the computer 802, or
3 portions thereof, may be stored in a remote memory storage device. By way of
4 example, remote application programs 858 reside on a memory device of remote
5 computer 848. For purposes of illustration, application programs and other
6 executable program components, such as the operating system, are illustrated
7 herein as discrete blocks, although it is recognized that such programs and
8 components reside at various times in different storage components of the
9 computer system 802, and are executed by the data processor(s) of the computer.

10 **Conclusion**

11 Logical semantic compression is particularly useful for records in data sets
12 that have data and a significant quantity of semantic information relative to the
13 size of the data. Logical semantic compression is also particularly useful when
14 considering the quantity of data to be transmitted to a destination device in relation
15 to the time that it takes to transmit the data over a slow bandwidth connection, for
16 example. Even when transmitting a data set over a fast connection, logical
17 semantic compression will decrease the time that it takes to transmit the data set if
18 the data set is large in proportion to the speed of the connection.

19 Although the systems and methods have been described in language
20 specific to structural features and/or methodological steps, it is to be understood
21 that the invention defined in the appended claims is not necessarily limited to the
22 specific features or steps described. Rather, the specific features and steps are
23 disclosed as preferred forms of implementing the claimed invention.